

EFFECTS OF OCCUPATIONAL CHANGES ON REHABILITATED WORKERS IN BRAZIL

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Abstract

This work investigates how an occupational change, after a professional rehabilitation process, affects the hourly wages of workers who are inserted in the formal job market in Brazil and its regions. For that purpose, a data panel was used with individual information from the Annual List of Social Information (*Relação Anual de Informações Sociais- RAIS*) for the period of 2007 to 2015. The methodology used was the method of Generalized Differences in Differences (GDD). The entropy balancing technique was also included, to ensure the robustness of the analysis. The main results show that there was a positive effect on the wages of the rehabilitated workers who changed their occupation after the rehabilitation process.

Keywords: Occupational Change; Professional Rehabilitation; Generalized Differences in Differences; Entropy Balancing; Brazil.

JEL classification: J38, J62, C54

Resumo

Este artigo investiga como a mudança de ocupação, após o processo de reabilitação profissional, afeta o salário-hora dos profissionais que estão inseridos no mercado de trabalho formal do Brasil e regiões. Para atender o objetivo, utilizou-se um painel de dados com informações individuais a partir de dados da Relação Anual de Informações Sociais (RAIS) para o período de 2007 a 2015. A avaliação foi feita por meio do método de diferenças em diferenças generalizadas (GDD). Para garantir a robustez da análise, optou-se por também utilizar a técnica do balanceamento por entropia. Os principais resultados mostram que houve um efeito positivo nos salários do profissional reabilitado que mudou de ocupação após a reabilitação.

Palavras-chave: Mudança ocupacional; Reabilitação Profissional; Diferenças em Diferenças Generalizadas; Balanceamento por Entropia; Brasil.

Classificação JEL: J38, J62, C54

1. INTRODUCTION

In the 2011, World Report on Disability by the World Health Organization - WHO and the World Bank defined rehabilitation as the process which assists individuals with functional limitations to interact with their environments, based on a set of measures. In other words, it is a way to recover the individual's social well-being.

Professional rehabilitation is a practice that aims to reinsert a worker who is temporarily unable to perform their professional activities due to some work related or unrelated accident or illness in the job market. According to the Statistical Yearbook of Social Security (*Anuário Estatístico da Previdência Social* – AEPS, 2015, p. 539): “it is a service that aims to provide insured persons, who are partially or totally incapacitated for work, regardless of need, and for individuals with disabilities the means for the re-education or professional and social rehabilitation, to participate in the job market and the context in which they live”.

After the first world war, when soldiers returned injured and with some type of disability, countries began to design specific policies to include those people who clearly needed of some training to reenter in the job market. Since then, those who had been injured began to be included in all kinds of occupations (THORNTON, 1998; METTS, 2000).

The International Labor Organization (ILO), in 1925, through Convention No. 19, entitled “Convention on Equal Treatment (Accident Compensation)” made the first recommendation to member countries of the United Nations to grant a minimum of compensation for workers injured at work, regardless of the professional's nationality.

Subsequently, in 1983¹, the ILO recommended that appropriate measures for professional rehabilitation should be adopted as well, which, aimed to promote the inclusion of these people in the job market at any cost.

In Brazil, the issue of functional readaptation, due to an accident at work is old and was published in the country's legislation even before the standards were established by the ILO. The Reform of Labor Accidents Act of 1944, was aimed at professionals who had an accident at work, as a way of enabling them to continue their career in their original job or in activities linked to their physical conditions. It is worth mentioning that professional rehabilitation services were provided through the practice of physiotherapy, orthopedic and reparative surgery, and also through education in special professional schools (Decree-law nº 7,036/44).

Professional rehabilitation services in Brazil are provided by the Brazilian National Institute of Social Security (*Instituto Nacional de Seguridade Social* - INSS). According to the INSS, the process includes: assessing the individual's work potential, as a way of measuring the real capacity of their return to work; leading the rehabilitated person to a conscious choice of a new job function / activity if necessary; articulating with the community, agreements and other such contracts aiming at the reinsertion of the worker; and conducting research on duration in the job market (INSS, 2017).

Those who have been away from work for reasons of accident or illness at work are beneficiaries with some amount of financial benefits until their full recovery². It should be noted that the insured person only receives the benefit after a medical evaluation reporting that they are unable to perform their work activities, as required by Law 8,213/91, for at least 15 days.

In view of the fact that the aid is temporary³, the beneficiaries are referred by the INSS to the worker rehabilitation process. In this process, a team of professionals is available to assist these individuals. In addition, the INSS also provides all resources, if necessary, such as prostheses, orthoses, work tools, professional implements and transportation aid, according to law 8,213/91.

¹Following recommendation 99, of 1955, on Qualification and Professional Rehabilitation of the Disabled and the recommendation on the development of human resources, 1975.

² Insured persons who have a permanent reduction in their work capacity, due to an accident, receive an indemnity benefit called “Accident Assistance” (*Auxílio Acidente*) (INSS, 2017).

³According to Law 8213/91, the insurance benefit will be maintained until the insured person is considered rehabilitated for activities that ensure their subsistence or until they are retired, for being unable to perform any work function.

After the end of the rehabilitation process, the INSS emits a certificate which indicates whether the beneficiary will be able to return to work or not, designating what functions he or she will be able to make. However, the fact that the worker has been rehabilitated does not guarantee that they will be automatically employed given that it is not mandatory to both the Social Security Service to keep these workers in the same job or allocate them in another position⁴.

On the other hand, since 1991, a federal law enforces the inclusion of people who have been professionally rehabilitated in the Brazilian job market, called the “Quota Law” (*Lei de Cotas*⁵). This law creates opportunities for the insured individuals to apply for a job vacancy, since it either individuals who went through some type of rehabilitation, or for people with disabilities, who did not necessarily go through any rehabilitation process.

Information from the Social Security Statistical Yearbook (AEPS, 2015) reveals that 25,652 were eligible for the rehabilitation process in Brazil in 2015 while 13,527 were rehabilitated. In that same year, according to data from the Annual List of Social Information (*Relação Anual de Informações- RAIS*⁶), 35,907 rehabilitated people were employed in the formal job market the country, converging approximately 8.9% of the total number of people with disabilities employed in the country.

Although the rehabilitation process is important for the worker's return to the job market, they are often unable to readjust to the normal activities on a daily basis after suffering the accident/illness. The same logic goes for their earnings. Thus, one interest in question is to investigate how wages of workers, who did not previously have functional limitations and received professional rehabilitation, were affected. Therefore, the objective of this paper is to evaluate the effects of job mobility for workers who were reinserted in the job market after the professional rehabilitation process in Brazil.

For this purpose, microdata from the Annual List of Social Information (*Relação Anual de Informações Sociais-RAIS*) are used, which allow the same individual to be followed over the years. Thus, it is possible to observe the occupational change of the worker who went through the rehabilitation process or not. The period of analysis will be for the years 2007 to 2015, since 2007 is the year where RAIS started identifying the worker's condition in relation to the disability and the type of disability that person could have, including whether they are rehabilitated or not. With this large interval of time, it is possible to make an analysis with a greater number of workers who had to leave their jobs, due to an accident or illness, and return to the job market in the condition of being a rehabilitated worker. Moreover, the method of differences in differences (DD) is used, making possible to assess how occupational change affects the hourly wages of the rehabilitated worker. Therefore, this research aims to contribute to the literature on this subject, which, to date, has not been studied extensively by the Brazilian economic literature.

This work is organized in four sections, including this introduction. While a brief literature review is presented in the section 2, the methodology and database are presented in the third section. The results can be seen in section four, followed by our concluding remarks in the section five.

2. Brief Literature Review

Although it is not researched as often as some other topics, analyzing the income and wages of individuals with disabilities, whether comparing with those who do have a disability, or comparing the same individual before and after a disability, has several contributions throughout the years. In this section, we briefly compile some of the more relevant contributions, both considering the international literature as a whole, and specifically works which analyzed Brazil.

⁴Decree 3,048/99

⁵ In 1991, a Brazilian law enforced companies to hire a percentage of people with disabilities, as well as rehabilitated workers through the Brazilian Social Security, according to the size of the establishment, being liable to a fine if they are not in compliance with the law.

⁶The authors wish to thank the Brazilian Ministry of Labor (Mtb) for making the data available.

2.1 International Literature

One early analysis of income differentials in individuals with and without disabilities is from DeLeire (2001). Using data from the *Survey of Income and Program Participation* for the United States, and considering the period of 1984 to 1993, the author suggests that the wage gap between people with work limitations and those without such limitations is due to the discrimination effect.

Another contribution is from Longhi *et al.* (2012) who, using the UK *Labour Force Survey*, analyzed the difference in wages for men with disabilities after the *Disability Discrimination Act* (DDA) was passed in the United Kingdom, considering data from 1997 to 2008. Wage differences were estimated in the mean and in the different quantiles of the wage distribution into which it is broken down into a “part explained by differences workers and job characteristics, the part that can be ascribed to health-related reduced productivity, and a residual part which we can more confidently interpret as discrimination”. According to the authors, much of the differences observed is associated with productivity issues.

Gunderson and Lee (2016), using data from the Participation and Activity Limitation Survey, analyzed wage discrimination people with disabilities in Canada for the year 2006. The methodology involves breaking down the wage gap between people with disabilities, who are not limited in the performance of their work and a comparison group of people without disabilities. The authors found that people with disabilities receive about 10% less than those without disabilities.

Some authors sought to examine the effects of programs which promote the inclusion of individuals with disabilities in the job market, such as Button (2017). As for Button (2017), the author evaluated the impact of the *Prudence Kay Poppink* (PKP) Act on the employment of individuals with disabilities. This law from California expands the antidiscrimination law in the United States, also assuring rights for those with less severe disabilities. Using data from the *Current Population Survey Annual Social and Economic Supplement* and the Differences-in-Differences-in-Differences method, the author finds that the PKP Act increased employment for those individuals or, at least, assured there was no job loss.

Bae *et al.* (2019) sought to analyze changes in worker income in South Korea, particularly those in the construction sector of the country, who experienced industrial accidents according to their “return to work” status. The authors used data from the fifth Panel Study of Workers’ Compensation Insurance. A repeated measure analysis of variance (ANOVA) method was used to compare annual differential incomes before and after the industrial accident, and a linear mixed model was used to investigate the changes in income from before to after the industrial accident according to the industry and return-to-work status.

The authors find that construction industry workers exhibited greater incomes before the accident, and showed significant decrease in their incomes after the industrial accident. Regression analysis for assessing changes in income after the industrial accident showed that a comparison by industry revealed a significantly greater reduction in income in the construction than service industry. A comparison by work status revealed significantly greater decreases in income in the reemployment and non-return to work groups than among those who returned to their original work (BAE ET AL., 2019).

Kambourov *et al.* (2020) argue, while analyzing workers going through a training program, that wages of participants in employer-sponsored training increase substantially, while wages of participants in government-sponsored training hardly change. In their view, there is a potential selection issue, where most of the government-sponsored trainees went through an occupational change, while most participants in employer-sponsored training are “occupation stayers”. The work’s empirical analysis is based on data from the National Longitudinal Survey of Youth 1979 (NLSY79). The NLSY79 is, according to the authors, the only US dataset that asks questions pertaining to participation in both employer and government training. Thus, it allows the construction of the individuals’ job histories, including occupational tenure and occupational mobility, and to control for individual fixed effects.

Kambourov *et al.* (2020) use propensity score matching and Ordinary Least Squares regressions and find that occupational mobility and government training are conditionally independent. As a result, the authors evaluate the effect of training on the human capital of participants by studying separately the

samples of occupational stayers and occupational switchers. On both samples, the results show a substantial positive effect of training on workers' human capital. The magnitude appears to be similar for the participants in employer and government-sponsored training programs.

2.2 Evidence for Brazil

As mentioned previously, works on the wage differential of individuals with disabilities in Brazil are scarce. However, some authors have discussed the matter on occasion.

Castro *et al.* (2019) sought to assess discrepancies in wages of individuals with disabilities in the Brazilian job market. Using the methodology featured in DeLeire (2001), and also data from the Brazilian National Health Survey (*Programa Nacional de Saúde - PNS*), for the year 2013, the authors found as a result the existence of a wage gap between individuals with disabilities and people who do not have disabilities, which can be explained by both the endowment (productivity) effect and the discrimination effect.

Becker (2019), on the other hand, assessed the effect of disability on employment and hourly wages in Brazil, using the same data from the previous work, for the same period. As a methodology, the author used the decomposition of the differences in remuneration in the quantiles of the wage distribution, and three groups were considered: non-disabled individuals, those who have disabilities and limitations in terms of work activities, and those with disabilities but without such limitations.

The main results of that work suggest that the observable characteristics explain, for the most part, the wage differences between the groups of non-disabled and people with disabilities who did not have limitations in relation to those who have disabilities with limitations in some of the higher quantiles.

According to Becker (2019), this result may be related to the fact that employers have a preference in allocating individuals who do not have functional limitations to positions that pay higher wages, as a way of complying with the Brazilian quota law, without having to make considerable changes in the physical structures of the business or the work routines.

3. Methodology and Data

3.1 Data

For this work, we use microdata from the Annual Social Information List (*Relação Anual de Informações Sociais - RAIS*), of the Brazilian Ministry of Labor (*Ministério do Trabalho - Mtb*). RAIS contains data on formal employment in Brazil, and the advantage of these microdata is that through them it is possible to track an individual over the years, through the Individual Taxpayer Register (*Cadastro de Pessoas Físicas - CPF*), forming a longitudinal panel of data. It is important to note that the panel built is unbalanced due to the number of observations not being the same for each year of the survey.

The variable that identifies whether the worker has a disability and the type of disability, including whether that person went through a rehabilitation process, was inserted and made available in the RAIS database in 2007. Thus, from then on, there was a variable covering employment relationships featuring people with disabilities. Therefore, the years chosen for this research were from 2007 to 2015.

It is worth mentioning that a problem related to the database, in terms of this work, is that there is no variable related to the degree of limitation of individuals in carrying out their activities. According to Baldwin and Choe (2014), depending on the nature of the limitation and the type of work they perform, workers with disabilities can have different types of productivity. An example mentioned by the authors is the issue of mobility: workers who have limitations in getting around may be less productive than people without limitations in jobs that require them to move frequently, while they may be more productive in occupations that do not require movement in the work environment. This can affect their employability and wages.

The sample consists of workers between 16 and 65 years of age⁷. Public servants were excluded, as it is assumed that when they go through the rehabilitation process and return to the job market, they receive the same wages, so there would be a possibility of overestimation in the results of the analysis. Following the same principle, members of the armed and military forces were also excluded, as suggested by Guimarães (2013), Costa, Souza and Guimarães (2015) and Mariano and da Costa (2015), since market forces do not determine their wages.

From 2007 to 2010, some variables had different names and formats and had to be standardized so that they were consistent over the years. Another filter was to exclude individual information that was duplicated in the database, since some workers had more than one link with the same company, or even in another company, and appeared more than once in the database.

The variables used are presented in table 01 below. The hourly wage (w/h) was used as a variable of interest, intended to assess whether the occupational change has positive or negative effects on this variable. The variable that captures the effect of the occupational change after the rehabilitation period for workers is the *treatment*time* variable. The *diff_treatment* variable will capture the effect of treatment exposure time for the treated group.

Table 01–Descriptions of the Variables

| Variable of interest | |
|-----------------------------|--|
| w/h | Hourly wages |
| Treatment Variables | |
| Treatment | Dummy variable which assumes value 1 if the worker belongs to the treatment group, 0 if not. |
| treatment*time | interaction between treatment and the period the worker went through treatment |
| diff_treatment | exposure time to treatment |
| Covariates | |
| Age | age of worker |
| Age ² | age of worker squared |
| education | Education dummy variable |
| Length of employment | The length of employment of the worker in the company (in months) |
| Region | Regional dummy variable |
| Occupation | Job occupation dummy variable. |

Source: Prepared by the authors.

Covariates were selected according to their importance to explain wage returns, as proposed by Mincer (1974). The *age* variable will indicate the effect of individuals' age on income. As the productivity of individuals decreases after a certain age, *age²* (age squared) was included in the model as a way of capturing the effect of decreased income. Therefore, positive and negative signs for age and age squared are expected, respectively.

In the education variable, the following dummies are featured: *illiterate*, *elementary school*, *high school*, *higher education* and *master_doctorate*. More educated individuals are expected to have higher hourly wages.

The *length of employment* variable, measured in months worked, is equivalent to a measure of experience. Usually, increases in earnings caused by the accumulation of employment time.

Another control that is added to the model are regional dummies: *southeast*, *south*, *northeast*, *Midwest* and *north*, the five different regions of Brazil. The basis of comparison will be the southeast region, since it concentrates most of the employed population.

⁷ The Brazilian Work and Social Security Card (*Carteira de Trabalho e Previdência Social*- CTPS) can be issued from the age of 14, but the registration of activities for young people between 14 and 16 years of age can only be done as a minor apprentice. In view of this, it was decided to consider the minimum age of 16 years.

Regarding the occupation groups, dummy variables are featured using the definitions in the Brazilian Classification of Occupations (*Classificação Brasileira de Ocupações- CBO*): Managers, science and arts professionals, high school level technicians, administrative service workers, service workers, salespeople and commercial service providers, agricultural workers, workers in the production of industrial goods and services, and repair and maintenance workers. The basis of comparison will be the group of workers in the production of industrial goods and services, since a large part of the sample is included in this group.

3.2 Treatment and Control Groups

To assess the effects on the hourly wages of those professionals who had occupational changes after a rehabilitation process, it is necessary to build two groups: a group featuring the treated, which is the group of interest in the analysis, and a control group, with individuals who adequately represent the situation of not having gone through the treatment. (FOGUEL, 2012). In the case of this work, the groups were defined as follows:

- **Treatment group:** Individuals who did not have any functional limitations and went through a rehabilitation process, changing occupations afterwards.
- **Control group:** Individuals who did not have any functional limitations and went through a rehabilitation process, but remained in the same occupations afterwards.

Although the two groups have undergone rehabilitation, only those in the treated group have gone through an occupational change after the process. Therefore, the control group serves as an adequate comparison, given that the return to the same occupation indicates that the professional was able to occupy his / her previously performed function, so they were not directly affected in the job market by the rehabilitation process.

3.3 Model specification

In the evaluation of public policies, the method of differences in differences (DD) is frequently used⁸. This method assesses the effect of the policy, using information from the treatment and control groups before and after an intervention. It consists of calculating a double difference: first, the differences between the averages of the outcome variable are calculated before and after the treatment period, and then the difference between the treated and control groups. One of the advantages is that the method controls unobservable characteristics (for example, motivation, optimism, self-discipline,) which do not vary in time (Foguel, 2012; Khandker, Koolwal and Samad, 2009). According to Angrist and Pischke (2009), the differences in differences model is a version of the fixed effects model.

Although this work does not intend to exclusively evaluate the effect of the rehabilitation process on hourly wages, it is possible to use this method for that analysis, because, in this case, what is considered an intervention is the occupational change after the professional rehabilitation of the worker. The pre-treatment period is when the professional is in a certain occupation and does not have any type of functional limitation, therefore, that individual did not undergo a rehabilitation process⁹.

Following Foguel (2012) and denoting $D = \{1,0\}$, in which D indicates the treatment situation (1 – treated, 0 – control) and $t = \{1,0\}$, being, respectively, the period before and after treatment, then the DD estimator can be given by:

$$\beta_{DD} = \{E[Y|D = 1, t = 1] - E[Y|D = 1, t = 0]\} - \{E[Y|D = 0, t = 1] - E[Y|D = 0, t = 0]\} \quad (1).$$

⁸ For further methodological details, see Foguel (2012), Khandker, Koolwal and Samad (2009), Angrist e Pischke (2009) e Cameron and Trivedi (2005).

⁹One hypothesis to be tested in the DD design, is that the control group result variable must represent the time trajectory that should occur with those treated in the absence of treatment. However, it is a difficult hypothesis to test and, therefore, what can be done is to test this assumption indirectly, assessing whether the two groups show the same trend with regard to the outcome variable in the pre-treatment period (FOGUEL, 2012).

In other words, it represents the time difference of what happened with the professionals who changed their occupation after the rehabilitation process, subtracted from the same difference calculated for the professionals who remained in the same occupations after this process.

The Differences in Differences (DD) model can be modified to the Generalized Differences in Differences (GDD) method, if there are more than two periods of time available for analysis. According to Pereira (2019), GDD is a more efficient way to estimate the DD model using panel data.

The Generalized Differences in Differences Method has been widely used in the literature, as can be seen in Lee (2016), Cordeiro Guerra and Lastra-Anadón (2018), Pereira (2019) and Graff and Pirog (2019). Thus, in this work, the GDD design will be used, in which the individual fixed effects (groups) and time fixed effects are included in the estimation. The specification of the model is as follows:

$$w/h_{it} = \beta_0 + \beta_1 Treatment_i x Time_t + \alpha_i + \delta_t + \mu_{it} \quad (2)$$

Where subscript i represents the workers, and t the period of time ($t=2007, 2008, \dots, 2015$). α_i is the control for the individuals' fixed effects, δ_t are the fixed effects in time, and μ_{it} is the error term. The parameter β_1 represents the interest parameters, as it identifies the direct effect of an occupational change on the result variables. In order to ensure greater robustness of the results, some other strategies were used. First, equation (2) is specified considering a vector of characteristics of the worker, X_{it} (as mentioned in Table 01):

$$w/h_{it} = \beta_0 + \beta_1 Treatment_i x Time_t + \beta_2 X_{it} + \alpha_i + \delta_t + \mu_{it} \quad (3)$$

This work considers the GDD method, however, the analysis is performed only for cases in which the parallel trends are confirmed graphically and, additionally, by the “placebo effect”¹⁰, as yet another form of robustness. As each individual went through the rehabilitation process in specific periods, thus being possible that they are featured in the database in any given year in the condition of rehabilitation, it was decided to leave in only those individuals who, from 2007 to 2009, did not undergo the rehabilitation process, that is, these years are considered as the pre-treatment period. The choosing of these years is due to the fact that, as of 2010, the proportion of rehabilitated individuals formally employed shows a continuous decline.

In addition to the analyzes already mentioned, it was decided to combine the GDD design with the entropy balancing technique, as featured in Freier *et al.* (2015). This technique consists of finding individuals (control) with characteristics similar to those treated in the pre-treatment period, estimating weights directly from a set of balance restrictions, according to Hainmueller (2012). That is, this method does a reweighting to adjust the sample distributions.

Let w_{it} be the balance weight for each control unit. This weight can be found by minimizing the metric entropy distance:

$$\min_{w_i} H(w) = \sum_{\{i|D=0\}} w_i \log(w_i / q_i) \quad (4)$$

Which is subjected to the following restrictions:

$$\sum_{\{i|D=0\}} w_i c_{ri}(X_i) = m, \text{ with } r \in 1, \dots, R \quad (5)$$

$$\sum_{\{i|D=0\}} w_i = 1 = m, \quad (6)$$

$$w_i \geq 0 \text{ for ever } y_i, \text{ such that } D = 0 \quad (7)$$

In which, these restrictions are, respectively, balancing restrictions, a normalization restriction and a non-negativity restriction. Furthermore, $q_i = 1/n_0$ is defined as the base weight, and $c_{ri}(X_i) = m$ is a set of restrictions imposed on the covariate moments in the weighted control group. These moments can

¹⁰In addition to the graphical analysis, the “placebo effect” is used, as featured in Lima (2018), similarly to the work of Gleewe and Kassouf (2012). In this case, the model for the pre-treatment period is estimated, as a way of showing that there is no effect from sources other than the occupational change after rehabilitation.

be broken down into three, namely: the mean (first moment), variance (second moment), and asymmetry (third moment). Thus, the method allows an exact balance to exist between the distributions of independent variables in the treatment and control groups.

Firstly, one should choose the covariates that will be included in the reweighting. That said, a set of balancing restrictions is determined, as in equation (5), so that the moments of the covariate distribution between treatment groups and weighted controls can be equated.

Therefore, in general, entropy balancing assigns weights $W = [w_i, \dots, w_{no}]'$ that minimize equation (4), which is the entropy distance between W and the weight base vector $Q = [q_i, \dots, q_{no}]'$, subject to the restrictions described.

4. RESULTS

4.1 Descriptive statistics

Table 02 below presents the descriptive statistics for the control and treated groups, considering the period prior to the rehabilitation process, and the subsequent period for Brazil. As shown, the hourly wage for both groups increases after the rehabilitation period, but those in the treated group feature lower hourly wages (R\$ 13.15) as compared to the control group (R \$ 15.75).

As for education, it is clear that for the control group the percentage of education in the sample is very close between the pre and post rehabilitation periods, with a minor change in percentages. In addition, it appears that there was greater growth between periods of people which were in the process of getting a college degree.

Regarding the different regions of Brazil, the statistics show that the largest concentration of people is in the Southeast region of the country, and it can also be noticed that in the treated group, there was an increase in the number of individuals in that region, while there is a decrease for the other regions, indicating that a considerable number of people are migrating to the Southeast.

Another relevant information is related to occupation groups. Since for the control group it is considered that there is no occupational change between periods, the percentage remains the same, with the industrial goods and services production group having the highest proportion of people. As for the treated group, before the rehabilitation period, approximately 32.9% of individuals is allocated in activities of the industrial goods and services production group, but this percentage drops to 25.8% after the rehabilitation process. On the other hand, there is a considerable increase in the activities of administrative service groups.

Table 02 – Descriptive Statistics for the control and treated groups, before and after the rehabilitation process – Brazil

| Variables | Control | | | | Treated | | | |
|--|---------|--------------------|--------|--------------------|---------|--------------------|-------|--------------------|
| | Pre | | Post | | Pre | | Post | |
| | mean | Standard-deviation | mean | Standard-deviation | mean | Standard-deviation | mean | Standard-deviation |
| Hourly wages | 13.95 | 1.58 | 15.16 | 15.60 | 10.48 | 12.23 | 13.5 | 12.44 |
| Age | 37.60 | 9.95 | 40.65 | 10.12 | 3.84 | 10.27 | 38.76 | 10.58 |
| Period of employment | 91.05 | 89.59 | 113.04 | 101.48 | 47.85 | 60.20 | 75.88 | 92.32 |
| Illiterate | 0.012 | 0.108 | 0.008 | 0.091 | 0.005 | 0.072 | 0.003 | 0.053 |
| Elementary school | 0.331 | 0.471 | 0.321 | 0.467 | 0.288 | 0.453 | 0.250 | 0.433 |
| High school | 0.520 | 0.500 | 0.519 | 0.500 | 0.587 | 0.492 | 0.580 | 0.494 |
| College degree | 0.135 | 0.342 | 0.148 | 0.355 | 0.119 | 0.324 | 0.163 | 0.370 |
| Masters_Doctorate | 0.002 | 0.048 | 0.003 | 0.058 | 0.002 | 0.039 | 0.004 | 0.065 |
| North_Northeast | 0.211 | 0.408 | 0.201 | 0.401 | 0.254 | 0.435 | 0.174 | 0.379 |
| South-east | 0.462 | 0.499 | 0.474 | 0.499 | 0.348 | 0.476 | 0.535 | 0.499 |
| South_Center-West | 0.327 | 0.469 | 0.319 | 0.466 | 0.398 | 0.490 | 0.291 | 0.454 |
| Managers | 0.016 | 0.125 | 0.016 | 0.125 | 0.023 | 0.150 | 0.017 | 0.128 |
| Artand Science professionals | 0.038 | 0.192 | 0.038 | 0.192 | 0.034 | 0.181 | 0.036 | 0.186 |
| High school level technicians | 0.104 | 0.306 | 0.104 | 0.306 | 0.070 | 0.256 | 0.080 | 0.271 |
| Administrative services | 0.189 | 0.392 | 0.189 | 0.392 | 0.262 | 0.440 | 0.399 | 0.490 |
| Commercial services | 0.123 | 0.328 | 0.123 | 0.328 | 0.136 | 0.343 | 0.129 | 0.335 |
| Salespeople and providers of commerce services | 0.035 | 0.183 | 0.035 | 0.183 | 0.072 | 0.259 | 0.037 | 0.189 |
| Agricultural workers | 0.050 | 0.218 | 0.050 | 0.218 | 0.044 | 0.205 | 0.024 | 0.154 |
| Workers in the production of industrial goods and services | 0.410 | 0.492 | 0.410 | 0.492 | 0.329 | 0.470 | 0.258 | 0.437 |
| Repair and maintenance workers | 0.035 | 0.183 | 0.035 | 0.183 | 0.030 | 0.171 | 0.021 | 0.144 |

Source: Prepared by the authors using data from the RAIS (MTb, 2018). Data from 2007 to 2015.

4.2 Effects on hourly-wages

The results of the effect of the occupational change after going through professional rehabilitation are shown in table 03. In model (1), estimates are made without considering covariates, while in the other models, the covariates are added. In model (3), unlike model (2), entropy balancing is performed¹¹. In the case of the models with covariates, there were no unexpected results, in terms of the discussion featured in the previous section¹². Furthermore, the *diff_treatment* variable, considered in models (2) and (3), which captures the time of exposure after rehabilitation and occupational change, was not statistically significant.

For Brazil, North-Northeast and Southeast, differently than could be expected, the effect of a change in occupation was positive in all models, that is, after the rehabilitation process, individuals who returned to the job market and were reinserted in other occupations, had higher pay per hour worked than those professionals who did not change occupations. In the South and Center-West regions, the positive

¹¹The balancing is featured in annex 1, at the end of this work.

¹²If further details on the results of covariate estimations are needed, please contact the authors.

effect was only observed in the first model. Although the effects were positive, the values are low in magnitude.

Table 03 - Effects of occupational changes after the rehabilitation process on Hourly wages

| Brazil and regions | (1) | (2) | (3) | N |
|------------------------|--------|--------|--------|--------|
| Brazil | 0.877* | 0.621* | 0.556* | 51.891 |
| Southeast | 1.124* | 0.987* | 0.879* | 16.723 |
| North_Northeast | 1.113* | 1.104* | 1.149* | 6.643 |
| South_Center-West | 0.725* | 0.333 | 0.456 | 17.562 |
| Time fixed effects | yes | yes | yes | |
| Control for covariates | no | yes | yes | |

Source: Prepared by the authors using data from the RAIS (MTb, 2018).

The standard errors presented in parentheses are robust to heteroscedasticity.

* Significant at the 5% level.

These positive results may be related. Firstly, regarding the issue of education, as shown in the descriptive statistics, the treated group had an increase in the level of education after the rehabilitation period. Another factor is the increase in the proportion of workers in administrative services.

What can be inferred is that the rehabilitated who changed their occupation had to increase their level of qualification to work in other activities that paid better, but that demand more specific knowledge. As a way of testing this statement, an estimation was performed by adding the interactions treatment*time with: *higher education*, *masters_doctorate* and *administrative services*. As featured in table 04, there was a positive effect in all these interactions for Brazil.

As for the different regions, there were disparate effects. In the Southeast, only the interactions with education were statistically significant, representing a positive effect. In the North-Northeast regions, there was no effect, and in the South-Central-West regions, there was only a positive effect with the interaction of higher education.

Table04–Effects of the interactions on hourly-wages

| Brazil and regions | Brazil | Southeast | North_Northeast | South_Center-West |
|-----------------------------------|--------|-----------|-----------------|-------------------|
| Treatment*time*higher_education | 0.189 | 1.434* | 1.090 | 1.263* |
| Treatment*time**masters_doctorate | 15.83* | 29.032* | 0.236 | 2.561 |
| Treatment*time**adm_services | 0.384 | 0.251 | 0.596 | -0.095 |
| Time fixedeffects | yes | yes | yes | yes |
| Control for covariates | yes | yes | yes | yes |

Source: Prepared by the authors using data from the RAIS (MTb, 2018).The standard errors presented in parentheses are robust to heteroscedasticity.*Significant at the 5% level.

As mentioned, the hypothesis to be tested in the differences in differences model is that the control group follows the same temporal trajectory as the treated group, with respect to the result variable, in the pre-treatment period. Therefore, the averages need not coincide, but follow the same trend. The graphs in Appendix 2 show the trajectory for the hourly wage variable and it can be seen that the two groups (treated and control) follow the same trend for all regions and Brazil.

In addition to the graphical analysis, the “placebo effect” was considered, as stated above. The results of the placebo estimate, table 05, show that there was no statistical significance for the pre-treatment period, showing that the results obtained from the effect of the occupational change on the rehabilitated professionals are robust.

Table 05 – Placebo Effect

| Brazil and regions | Brazil | Southeast | North_Northeast | South_Center-West |
|------------------------|--------|-----------|-----------------|-------------------|
| 2007*treatment | -0.220 | 0.285 | -0.656 | 0.530 |
| 2008*treatment | -0.037 | 0.269 | -0.365 | 0.534 |
| 2009*treatment | -0.151 | -0.079 | -0.257 | -0.317 |
| Time fixedeffects | yes | yes | yes | yes |
| Control for covariates | yes | yes | yes | yes |

Source: Prepared by the authors using data from the RAIS (MTb, 2018). The standard errors presented in parentheses are robust to heteroscedasticity.

5. CONCLUDING REMARKS

This work sought to evaluate the possible effects of an occupational change, by individuals who went through a professional rehabilitation process, on hourly wages worked in the formal job market in Brazil and its regions, contributing, thus, to the literature, considering the rarity of national economic studies dealing with this subject.

The analysis was made using data from the Annual List of Social Information (*Relatório Anual de Informações Sociais - RAIS*), from the Brazilian Ministry of Labor (*Ministério do Trabalho – Mtb*), and the method of Generalized Differences in Differences. In addition, as a way to guarantee the robustness of the results, the entropy balancing method was used, which consists of finding a control group with characteristics similar to those in the treatment group in the pre-treatment period, estimating weights directly from a set of equilibrium restrictions.

The main results for Brazil are shown to be positive, but low effects on the hourly wages of the rehabilitated who changed their occupation, compared to the rehabilitated who did not go through an occupational change. As for the different Brazilian regions, there were positive effects of an occupational change after professional rehabilitation in the all of the models for the Southeast and the North and Northeast regions. For the South and Center-West regions, this effect was only observed in the first model.

What can be inferred, in general, is that those in the treatment group have probably sought more educational qualifications, and have shifted to activities that may require more specific knowledge. Therefore, these changes in education level and type of occupation may explain the positive effect on hourly wages.

Although this work has shown positive results, it can frequently occur that these individuals, due to their limitations, may face difficulties to obtain further professional qualification. Therefore, the importance of investments in policies aimed at guaranteeing admission to schools, professional courses and higher education institutions is emphasized, with actions that ensure that the physical structure and technological equipment are accessible. It is necessary to understand that some of these people may not be able to continue their studies and are unable to obtain the necessary qualifications for a particular activity, due to restrictions in the educational environment itself.

Among the limitations of this research, one can mention the scarce economic literature that deals with people with disabilities, especially with regard to rehabilitated professionals. In addition, there are restrictions in the databases that are disclosed, for example, in the case of RAIS, which does not have any variables related to the degree of limitation of people with disabilities, which can delimit the occupations that these people may be inserted in.

Therefore, the results found here suggest that the condition of those individuals which went through a professional rehabilitation and an occupational change in the formal job market, in a way, is improving, but there are still many workers who, due to their limitations, may be unemployed or working in the informal market, who were measured in this study. This reinforces the Government's performance in compliance with the Brazilian Quota Law, which aims to include these people in the job market, as well as reinforcing the attention that companies must have, and the appropriate working conditions that must be offered to workers, to avoid accidents at the workplace.

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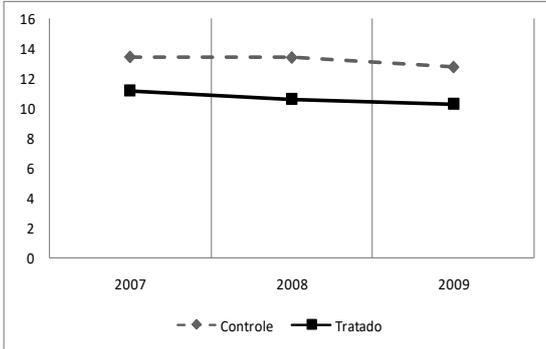
Appendix 1

EntropyBalancing

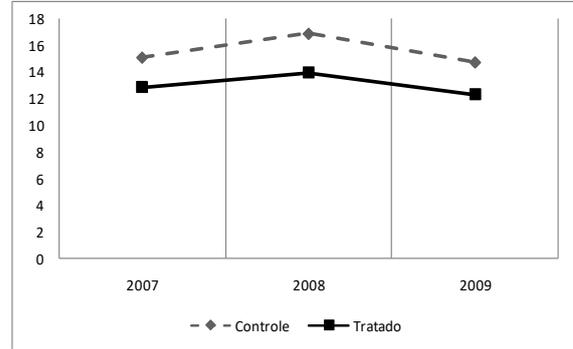
| Variables | Treatment | | | Control | | | | | | p-value | |
|--|-----------|----------|----------|-----------------|----------|----------|----------------|----------|----------|---------|-------|
| | Mean | Variance | Asymetry | Beforebalancing | | | Afterbalancing | | | Before | After |
| | | | | Mean | Variance | Asymetry | Mean | Variance | Asymetry | | |
| age | 34.87 | 108.40 | 0.43 | 37.59 | 104.00 | 0.24 | 34.87 | 108.40 | 0.43 | 0.000 | 0.966 |
| Periodofemployment | 57.22 | 5203.00 | 2277.00 | 94.36 | 8534.00 | 1302.00 | 57.25 | 4024.00 | 2097.00 | 0.000 | 0.985 |
| Elementar school | 0.29 | 0.20 | 0.95 | 0.34 | 0.22 | 0.70 | 0.29 | 0.20 | 0.95 | 0.000 | 0.998 |
| High school | 0.58 | 0.24 | -0.33 | 0.51 | 0.25 | -0.06 | 0.58 | 0.24 | -0.33 | 0.000 | 0.995 |
| Collegedegree | 0.13 | 0.11 | 2238.00 | 0.14 | 0.12 | 2136.00 | 0.13 | 0.11 | 2238.00 | 0.015 | 0.998 |
| masters_doctorate | 0.00 | 0.00 | 24.09 | 0.00 | 0.00 | 20.01 | 0.00 | 0.00 | 24.09 | 0.069 | 0.998 |
| managers | 0.02 | 0.02 | 6868.00 | 0.02 | 0.02 | 7742.00 | 0.02 | 0.02 | 6868.00 | 0.002 | 1.000 |
| High school level technicians | 0.07 | 0.07 | 3269.00 | 0.10 | 0.09 | 2658.00 | 0.07 | 0.07 | 3269.00 | 0.000 | 0.998 |
| Artsandsciencesprofessionals | 0.31 | 0.21 | 0.82 | 0.18 | 0.15 | 1625.00 | 0.31 | 0.21 | 0.82 | 0.057 | 1.000 |
| Administrativeservices | 0.13 | 0.12 | 2166.00 | 0.12 | 0.11 | 2293.00 | 0.13 | 0.12 | 2166.00 | 0.000 | 1.000 |
| Commercialservices | 0.06 | 0.06 | 3656.00 | 0.04 | 0.04 | 4747.00 | 0.06 | 0.06 | 3656.00 | 0.003 | 0.998 |
| Salespeople and providers of commerce services | 0.04 | 0.04 | 4744.00 | 0.05 | 0.05 | 4122.00 | 0.04 | 0.04 | 4744.00 | 0.000 | 0.997 |
| Agricultural workers | 0.30 | 0.21 | 0.85 | 0.41 | 0.24 | 0.35 | 0.30 | 0.21 | 0.85 | 0.000 | 0.997 |
| Workers in the production of industrial goods and services | 0.03 | 0.03 | 5613.00 | 0.04 | 0.04 | 4859.00 | 0.03 | 0.03 | 5613.00 | 0.000 | 1.000 |
| Southeastregion | 0.43 | 0.25 | 0.27 | 0.48 | 0.25 | 0.06 | 0.43 | 0.25 | 0.27 | 0.000 | 0.997 |
| North_Northeastregions | 0.22 | 0.17 | 1367.00 | 0.20 | 0.16 | 1471.00 | 0.22 | 0.17 | 1367.00 | 0.000 | 0.999 |

Source: Prepared by the authors using data from RAIS (Mtb, 2018)

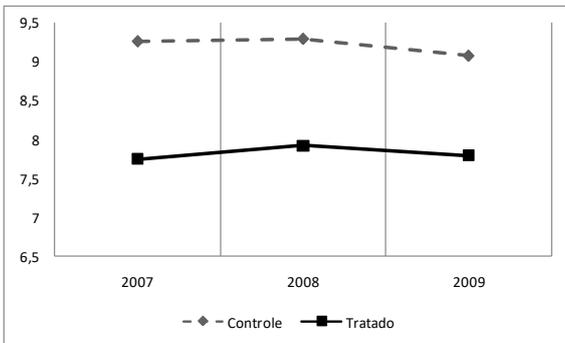
Appendix 2



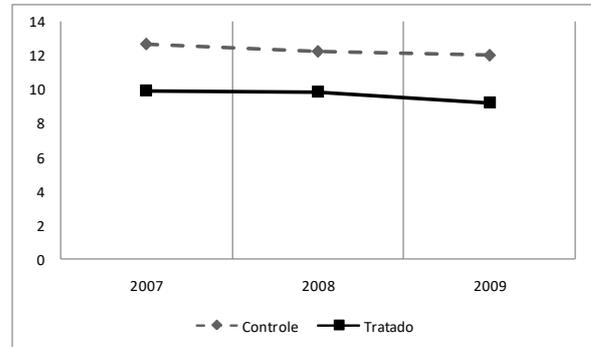
Graph 01 –Hourly wages of the treatment and control groups (2007 to 2009) – Brazil.
 Source: Prepared by the authors using data from RAIS (MTb, 2018).
 Note: Values at 2015 price level.



Graph 02 - Hourly wages of the treatment and control groups (2007 to 2009) – Southeast region.
 Source: Prepared by the authors using data from RAI(MTb, 2018).
 Note: Values at 2015 price level



Graph 03 - Hourly wages of the treatment and control groups (2007 to 2009) – North_Northeast regions.
 Source: Prepared by the authors using data from RAIS (MTb, 2018).
 Note: Values at 2015 price level



Graph 04 - Hourly wages of the treatment and control groups (2007 to 2009) – South_Center-West regions.
 Source: Prepared by the authors using data from RAIS (MTb, 2018).
 Note: Values at 2015 price level